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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/735,190	12/12/2003	Sung-Koog Oh	5000-1-406	2584

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EXAMINER	
ROJAS, OMAR R	
ART UNIT	**PAPER NUMBER**
2874	

DATE MAILED: 06/14/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/735,190	OH ET AL.	
	Examiner	Art Unit	
	Omar Rojas	2874	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *18 February 2005*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-6* is/are pending in the application.

4a) Of the above claim(s) ____ is/are withdrawn from consideration.

5)☐ Claim(s) ____ is/are allowed.

6)☒ Claim(s) *1-4* is/are rejected.

7)☒ Claim(s) *5 and 6* is/are objected to.

8)☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *December 12, 2003* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. ____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *0205*.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. ____ .

5) ☐ Notice of Informal Patent Application (PTO-152)

6) ☒ Other: *Detailed Action*.

DETAILED ACTION

Priority

1. Receipt is acknowledged of papers submitted under 35 U.S.C. 119(a)-(d), which papers have been placed of record in the file.

Information Disclosure Statement

2. The prior art documents submitted by applicant in the Information Disclosure Statement(s) filed on February 18, 2005 have all been considered and made of record (note the attached copy of form(s) PTO-1449).

Specification

3. The disclosure is objected to because of the following informalities: In the Abstract, line 10 and page 3, lines 14-15 of the specification, the term "zero dispersion wavelength" should read "zero dispersion slope" so as to be in accordance with the description of the invention.

Appropriate correction is required.

Claim Objections

4. Claim1 is objected to because of the following informalities: In claim 1, line 10, the term "zero dispersion wavelength" should read "zero dispersion slope" so as to be in accordance with the description of the invention.

Appropriate correction is required.

Claim Rejections - 35 USC § 102

5. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

6. Claims 1-4 are rejected under 35 U.S.C. 102(a) as being anticipated by JP 2002-258092 to Furukawa (hereinafter "Furukawa"), provided by applicant(s) in the information disclosure statement.

A machine translation of the Furukawa reference (hereinafter "the translation") has been provided and is referred to below.

Regarding claim 1, Furukawa teaches an optical fiber having a refractive profile (e.g., see Figure 1) comprising:

a core area 6 extended along a predetermined reference axis;

a cladding area 5 formed around the external circumference of the core area, wherein the radii of the core area and cladding area and the refractive profile are selectively selected so that the optical fiber has the following characteristics:

a zero dispersion wavelength in the range of 1300 to 1350 nm (see Furukawa, Table 1 on page 5);

a dispersion value in the range of 13 to 18 ps/nm*km at 1550 nm wavelength (see Furukawa, Table 1 on page 5);

a zero dispersion slope greater than 0.7 ps/nm^2*km (see the translation at paragraph [0011]; see also the Derwent English abstract of the Furukawa reference, submitted by applicant(s)); and,

an effective cross-section area of 70 microns or more (see Furukawa, Table 1 on page 5).

Regarding claims 2 and 3, Figures 5 and 9 of Furukawa clearly suggest the recited limitations.

Regarding claim 4, as seen in his Figures 2 and 6, the refractive index of the cladding 5 decreases slightly as the radius or diameter increases. Therefore, Furukawa also teaches a depressed clad type optical fiber.

Allowable Subject Matter

7. Claims 5 and 6 objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

8. The following is a statement of reasons for the indication of allowable subject matter:

Regarding claim 5, Furukawa is considered the closest available prior art. In the examiner's opinion, it would not have been obvious to use an index-matched clad type optical fiber in Furukawa. This particular feature is shown in Figure 2 of the application drawings and is considered patentably distinguishable over Furukawa. Therefore, the subject matter of claim 5 is deemed allowable.

Regarding claim 6, Furukawa is considered the closest available prior art. In the examiner's opinion, it would not have been obvious to use the radial dimensions recited by claim 6 in Furukawa. The examples given by Furukawa in tables 1-3 show a core having a diameter of at least 18 microns which is equivalent to core radius of 9 microns. This dimension is much larger

than the core radius recited by claim 6. Therefore, the subject matter of claim 6 is deemed allowable.

Conclusion

9. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. With regards to the prior art cited in the search report for European application no. EP 04 001315 (also provided by applicant(s)), the examiner has studied the references cited in the search report and has determined that only the aforementioned Furukawa reference teaches all the limitations recited by claim 1. Patent Publication Nos. 2004/0218882 and 2002/0051612 disclose optical fibers having most, but not all, of the characteristics recited by claim 1.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Omar Rojas whose telephone number is (571) 272-2357. The examiner can normally be reached on Monday-Friday (7:00AM-3:00PM).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Rod Bovernick, can be reached on (571) 272-2344. The official facsimile number for regular and After Final communications is (703) 872-9306. The examiner's RightFAX number is (571) 273-2357.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Omar Rojas
Patent Examiner
Art Unit 2874

or
June 9, 2005

Form PTO-1449 IRSY. 7.801 U.S. Department of Commerce Patent and Trademark Office	ATTORNEY DOCKET NO.	5000-1-406
	SERIAL NO.	10/735,190
LIST OF DOCUMENTARY INFORMATION CITED BY APPLICANT (Use several sheets if necessary)	APPLICANT	Sung-Koog Oh et al.
	FILING DATE	December 12, 2003
	GROUP	Unassigned

U.S. PATENT DOCUMENTS

EXAMINER INITIAL		DOCUMENT NUMBER	DATE	NAME	CLASS	SUB-CLASS	FILING DATE IF APPROPRIATE
On	AA	5,905,838	5/18/99	Judy et al.	385	123	2/18/98

FOREIGN PATENT DOCUMENTS

		DOCUMENT NUMBER	DATE	COUNTRY	CLASS	SUB-CLASS	TRANSLATION YES	NO
On	AB	JP2002258092	9/11/02	Japan	G02B	6/22	X	
	AC	EP1030200	8/23/00	Europe	G02B	6/22	X	
	AD	WO 02/31553	4/18/02	PCT	G02B	6/22	X	
	AE	EP 1233288	8/21/02	Europe	G02B	6/22	X	
	AF	EP1109039	6/20/01	Europe	G02B	6/16	X	
	AG	WO 00/36443	6/22/00	PCT	G02B	6/16	X	
	AH	EP1107027	6/13/01	Europe	G02B	6/16	X	

OTHER PRIOR ART (Including Author, Title, Date, Pertinent Pages, Etc.)

EXAMINER: [signature] DATE CONSIDERED: 6/5/05

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609; Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

Notice of References Cited

Notice of References Cited	Application/Control No. 10/735,190	Applicant(s)/Patent Under Reexamination OH ET AL.
	Examiner Omar Rojas	Art Unit 2874 | Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
	A	US-2002/0051612	05-2002	Shimizu et al.	385/123
	B	US-2004/0218882	11-2004	Bickham et al.	385/127
	C	US-			
	D	US-			
	E	US-			
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	Machine translation of JP 2002-258092A downloaded on June 9, 2005 from http://www.ipdl.ncipi.go.jp/homepg_e.ipdl.
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Machine Translation for JP 2002258092

* NOTICES *

JPO and NCIPI are not responsible for any damages caused by the use of this translation.

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the optical fiber which enables wavelength multiplex transmission in the large wavelength range.
[0002]
[Description of the Prior Art] It is in the inclination for communication link amount of information to increase by leaps and bounds, by development of an information society, and the wavelength multiplex transmission (WDM transmission) technique attracts attention with increase-izing of such information. Since wavelength division multiplex transmission is a method which transmits the light of two or more wavelength with one optical fiber, it is an optical transmission method suitable for a mass high-speed communication link, and examination of current and this transmission technique is performed briskly.
[0003] In order to prevent noise generating by 4 light-wave mixing whose transmission loss is one of the nonlinear phenomena not to mention a small thing, it is required for the single-mode optical fiber applied as the above-mentioned object for wavelength multiplex transmission that a variance should not become zero in an operating wavelength region. In addition, wavelength the band of 1.55 micrometers (for example, central wavelength range [wavelength / of 1550nm] like 1530nm - 1570nm almost) which is the gain band of an erbium dope optical fiber mold optical amplifier performs wavelength multiplex transmission by which current examination is carried out.
[0004] As an optical fiber with which a variance does not become zero in wavelength the band of 1.55 micrometers, there is a single mode optical fiber (only henceforth a single mode optical fiber) which has zero distribution with 1.3-micrometer band. Since the variance in wavelength the band of 1.55 micrometers is large, when applying a single mode optical fiber to wavelength multiplex transmission, as for the single mode optical fiber, it is common to combine the distributed compensator with which distribution of a single mode optical fiber is compensated in wavelength the band of 1.55 micrometers.
[0005] Moreover, the optical fiber which the variance adjusted [optical fiber] the refractive-index profile of the distributed shift optical fiber of zero with the wavelength band of 1.55 micrometers developed conventionally, and shifted zero distribution wavelength to the short wavelength or long wavelength side slightly is also proposed for the variance in the wavelength band of 1.55 micrometers as an optical fiber which does not become zero. since the optical fiber of this example 1 of a proposal has the small absolute value of a variance in wavelength the band of 1.55 micrometers -- the above distributed compensators -- needlessness -- or even when using it, it is good in the small amount of compensation.
[0006] However, the optical fiber of this example 1 of a proposal has many additions of germanium, since the diameter of the mode field is small, its effective core cross section in wavelength the band of 1.55 micrometers is small, and nonlinearity appears strongly. Therefore, even if the optical fiber of the example 1 of a proposal controls 4 light-wave mixing which is one of the nonlinear phenomena, the wave-like turbulence by self-phase modulation (SPM), a mutual phase modulation (SPM), etc. which are other nonlinear phenomena produces it.
[0007] Then, although the optical fiber of the example 2 of a proposal which improves the optical fiber of the example 1 of a proposal, and has the same distributed property as the example 1 of a proposal, and expanded the effective core cross-sectional area in wavelength the band of 1.55 micrometers to two or more [70-micrometer] was proposed, since the optical fiber of this example 2 of a proposal also had many additions of germanium, transmission loss was large.
[0008]
[Problem(s) to be Solved by the Invention] By the way, it corresponds to the demand of a transmission wavelength region expansion in recent years, and considering the Raman amplifier as application use for wavelength division multiplex transmission came to be proposed instead of said erbium dope fiber mold optical amplifier. If this Raman amplifier is applied, since magnification gain can be acquired in the wavelength of arbitration, the wavelength range of the arbitration of wavelength within the limits of 1.3 micrometers - 1.6 micrometers is set up as a wavelength range for

wavelength division multiplex transmission, for example, and it is expected that wavelength division multiplex transmission can be performed using the lightwave signal of this setting wavelength range.

[0009] However, as mentioned above, since examination had been performed as an object for wavelength division multiplex transmission in wavelength the band of 1.55 micrometers, no optical fibers conventionally examined for wavelength division multiplex transmission were optical fibers which enable wavelength division multiplex transmission using the lightwave signal of the above-mentioned setting wavelength range.

[0010] This invention is accomplished in order to solve the above-mentioned technical problem, and the purpose is in offering the optical fiber which can enable wavelength division multiplex transmission of high quality in the setting wavelength range of within the limits with a wavelength of 1.3 micrometers - 1.6 micrometers.

[0011]

[Means for Solving the Problem] In order to attain the above-mentioned purpose, this invention has the following configurations and makes them The means for solving a technical problem. That is, the 1st invention is a silica glass fiber which comes to add germanium to the core of a core at least, and is taken as a means to solve a technical problem with the configuration which made the variance in the wavelength of 1520nm - the wavelength of 1600nm 10-22ps/km-nm, set zero dispersive wave length to 1350**30nm, and made the distributed inclination in this zero dispersive wave length the larger value than 0.07 ps(es)/nm2/km.

[0012] Moreover, in addition to the configuration of invention of the above 1st, 2nd invention is taken as a means to solve a technical problem with the configuration which made the effective core cross section in the wavelength of 1550nm two or more [90-micrometer].

[0013] Furthermore, in addition to the configuration of the above 1st or the 2nd invention, 3rd invention is taken as a means to solve a technical problem with the configuration which carried out transmission loss in the wavelength of 1550nm in 0.21dB/km or less.

[0014] Furthermore, in addition to the configuration of the above 1st, the 2nd, or the 3rd invention, 4th invention is taken as a means to solve a technical problem with the configuration which set cut-off wavelength to less than 1300nm.

[0015] Furthermore, the 5th invention is added to the configuration of the above 1st thru/or any 4th one invention, and is taken as a means to solve a technical problem with the configuration which carried out the transmission loss value of with wavelength [of 1300nm] - a wavelength of 1550nm wavelength within the limits in about 0.35dB/km or less.

[0016] Furthermore, the 6th invention is added to the configuration of the above 1st thru/or any 5th one invention. Said core has the 2nd glass layer formed in the periphery side of the 1st glass layer formed in the innermost part of an optical fiber, and this 1st glass layer. The typical floor used as the criteria of refractive-index distribution is prepared in the periphery side of this 2nd glass layer. Said 1st glass layer has a refractive index higher than said typical floor, and the refractive-index distribution configuration is presenting alpha **, and said 2nd glass layer is made into a means to solve a technical problem with a configuration with a low refractive index and a refractive index higher than said typical floor rather than said 1st glass layer.

[0017] Furthermore, in addition to the configuration of invention of the above 6th, 7th invention is taken as a means to solve a technical problem with the configuration which formed said 1st glass layer and 2nd glass layer by the vacuum arc heating decarbonizing process of the same process, and formed the typical floor at another process.

[0018] Furthermore, in addition to the configuration of invention of the above 6th, 8th invention is taken as a means to solve a technical problem with the configuration which formed a part of core approach of said 1st glass layer, the 2nd glass layer, and a typical floor by the vacuum arc heating decarbonizing process of the same process.

[0019] Furthermore, in addition to the configuration of invention of the above 8th, 9th invention is taken as a means to solve a technical problem with the configuration the fluorine is added by whose typical floor formed by said vacuum arc heating decarbonizing process.

[0020] Furthermore, in addition to the configuration of the above 6th or the 7th invention, 10th invention is taken as a means to solve a technical problem with the configuration in which the 3rd glass layer with a refractive index lower than this typical floor is prepared between said 2nd glass layers and typical floors.

[0021] Furthermore, in addition to the configuration of invention of the above 10th, 11th invention is taken as a means to solve a technical problem with the configuration by which the fluorine is added in said 3rd glass layer.

[0022] Furthermore, in addition to the configuration of the above 6th thru/or any 11th one invention, 12th invention is taken as a means to solve a technical problem with the configuration by which germanium is added in said 1st glass layer and 2nd glass layer.

[0023] Furthermore, when the 13th invention sets the minimum relative index difference [as opposed to said typical floor of delta 1 and the 2nd glass layer for the maximum relative index difference over the typical floor of said 1st glass layer] to delta 2 in addition to the configuration of the above 6th thru/or any 12th one invention, It is considering as a means to solve a technical problem with the configuration which set the outer diameter of the 1st glass layer to 0.3 <= (a/b) <=0.7 when the outer diameter of a and the 2nd glass layer was set to b, 0.35%<=delta1 <=0.7% and delta2

<=0.3%.
[0024] Since zero dispersive wave length is set to 1350**30nm and the distributed inclination in this zero dispersive wave length is made into the larger value than 0.07 ps(es)/nm2/km in this invention of the above-mentioned configuration Can carry out the variance by the side of 20nm long wavelength to 1.4ps(es)/more than km-nm rather than zero dispersive wave length, and it sets rather than zero dispersive wave length to the wavelength range more than the wavelength by the side of 20nm long wavelength (for example, wavelength range 1400nm or more). Or in the wavelength range below the wavelength by the side of 20nm short wavelength (for example, wavelength range 1300nm or less), the signal light distortion by 4 light-wave mixing can be controlled rather than zero dispersive wave length.
[0025] In addition, if the upper limit of zero dispersive wave length is set to 1280nm, wavelength division multiplex transmission which controlled the signal light distortion by 4 light-wave mixing with the wavelength band of 1300nm can be performed.
[0026] Moreover, in this invention, since the variance in the wavelength of 1520nm - the wavelength of 1600nm is made into 10-22ps/km-nm, in this wavelength within the limits, control of the signal light distortion by 4 light-wave mixing is attained at least.
[0027] In addition, when making a signal-transmission rate with wavelength [of 1520nm] - a wavelength of 1600nm wavelength within the limits at the high speed of 10 or more Gbit/S, it is desirable to use a proper distributed compensation means together.
[0028] Moreover, in this invention, in the configuration which made the effective core cross section in the wavelength of 1550nm two or more [90-micrometer], since the effective core cross section can be enlarged not to mention the wavelength of 1550nm also in the wavelength range (for example, 1400nm - 1600nm) of the circumference of it, control also of the signal light distortion by nonlinear phenomena other than 4 light-wave mixing is certainly attained.
[0029] Furthermore, in this invention, in the configuration which carried out transmission loss in the wavelength of 1550nm in 0.21dB/km or less, transmission loss in this wavelength can be made very small, and it is made to the optical fiber which fitted wavelength division multiplex transmission further.
[0030] Furthermore, in this invention, implementation of wavelength division multiplex transmission in the wavelength range exceeding the wavelength of 1300nm can be aimed at by setting cut-off wavelength to less than 1300nm.
[0031]
[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained based on a drawing. The refractive-index profile of the example of the 1st operation gestalt of the optical fiber concerning this invention is shown in drawing 1 .
[0032] As shown in this drawing, the optical fiber of this example of an operation gestalt has the core 6 which has the 2nd glass layer 2 formed in the periphery side of the 1st glass layer 1 formed in the innermost part of an optical fiber, and this 1st glass layer 1. The clad 5 as a typical floor used as the criteria of refractive-index distribution is formed in the periphery side of the 2nd glass layer 2.
[0033] A refractive index is higher than a clad 5, and the refractive-index distribution configuration is presenting alpha **, and the 2nd glass layer 2 has [a refractive index is lower than said 1st glass layer 1, and] a refractive index higher [the 1st glass layer 1] than a clad 5. That is, it is delta1>delta2, when relative index difference over the clad 5 of the 1st glass layer 1 is set to delta 1 and relative index difference over the clad 5 of the 2nd glass layer 2 is set to delta 2.
[0034] Thus, the refractive-index profile of the optical fiber of this example of an operation gestalt is the so-called dual core fabric, and since a dual core fabric is comparatively easy structure, it is desirable at the point that reduction of a manufacturing cost can be aimed at.
[0035] As the optical fiber of this example of an operation gestalt is shown below, it is manufactured. That is, the glass base material (porosity base material) with which it has first the refractive-index profile shown in drawing 2 , and some clads 5 were formed in the periphery side of a core 6 is compounded by the vacuum arc heating decarbonizing process using three burners 11, 12, and 13 for a reaction, as shown in drawing 3 R> 3.
[0036] Under the present circumstances, from the burners 11 and 12 for a reaction which form a core 6 to jet gas, a germanium tetrachloride is mixed, respectively, thereby, germanium is added to a core 6 and germanium is not added to a clad 5 by not adding germanium from the burner 13 for a reaction which forms a clad 5 to jet gas.
[0037] In addition, like common knowledge, an optical fiber draws a line, and a glass base material is obtained, and it has applied this manufacture approach also in this example of an operation gestalt. Therefore, the relative index differences delta 1 and delta 2 in the refractive-index profile of drawing 2 are the same as that of drawing 1 , and the paths of the 1st and 2nd glass layers 1 and 2 differ.
[0038] After composition of the above-mentioned glass base material, it dehydrates, and transparence vitrification is carried out, and a glass base material is extended so that it may become a setting outer diameter. Then, with the so-called outside vapor phase deposition method, the remaining clad part is compounded and the base material for drawing is obtained. Then, a line is drawn so that a glass outer diameter may be set to 125 micrometers, and it considers as an optical fiber strand. In addition, in this optical fiber strand, when having fully performed deOH radical processing and

•producing a plastic coated fiber using this optical fiber strand, covering of ultraviolet-rays hardening resin was prepared in the periphery side of an optical fiber strand, and it considered as the outer diameter of 250 micrometers.
[0039] As a result of evaluating the optical transmission property of the above-mentioned optical fiber strand, the result shown in Table 1, drawing 4 , and drawing 5 was obtained.
[0040]
[Table 1]

	Δ1	α	Δ2	a/b	コア径b	1550分散値	零分散波長	零分散勾配	Aeff	λc
単位	%		%		μm	ps/km·nm	nm	ps/km·nm^2	μm^2	nm
	0.40	3	0.11	0.55	18.2	14.75	1347	0.08	102.7	1480

[0041] In addition, in each table shown below, 1550 variances show the variance in the wavelength of 1550nm, zero distribution inclination shows the distributed inclination in zero dispersive wave length, a/b shows the ratio of the path a of the 1st glass layer 1, and the path b of the 2nd glass layer 2, and lambdac shows [Aeff shows the effective core cross section in the wavelength of 1550nm (1.55 micrometers), and] the cut-off wavelength in die length of 22m. In addition, in this example of an operation gestalt, since it is dependent on the die length and the bending property of an optical fiber, cut-off wavelength can set cut-off wavelength to 1300nm or less, when it is made into a cable 1km or more.
[0042] In this example of an operation gestalt, 102.7 micrometers of effective core cross sections [in / in distributed inclination / in / variance / in the wavelength of 1550nm / in 14.75ps(es)/km-nm and zero dispersive wave length / 1347nm and zero dispersive wave length / 0.08ps(es)/km-nm2 and the wavelength of 1550nm] were set to 2 so that clearly from Table 1. Moreover, although not shown in Table 1, bending loss for the diameter phi of 30mm in the wavelength of 1550nm became 0.1 dB/m.
[0043] Moreover, in this example of an operation gestalt, since deOH radical processing has fully been performed, the transmission loss value near the wavelength of 1380nm did not become extremely large, and transmission loss has been controlled in the range at about 0.35dB or less in wavelength of 1300nm - 1620nm, so that clearly from drawing 4 .
[0044] In addition, although other transmission loss will be pulled when not controlling the OH radical absorption peak near the wavelength of 1380nm, and the transmission loss value near the wavelength of 1380nm (peak value) becomes 0.4 or more dB/m and becomes so In this example of an operation gestalt, since absorption by the OH radical is controlled, the transmission loss value in other fields is also stable, and wavelength division multiplex transmission can be performed in a large wavelength field, without receiving the bad influence of transmission loss.
[0045] Therefore, in this example of an operation gestalt, it makes to be able to make good wavelength division multiplex transmission in the wavelength range near the wavelength of 1550nm into the start, and it can cross to the large range of the wavelength of about 1290nm - the wavelength of about 1330nm and the wavelength of about 1400nm - 1620nm wavelength, and wavelength division multiplex transmission can be enabled.
[0046] In addition, when it is going to expand the effective core cross-sectional area in the wavelength of 1550nm to two or more [80-micrometer], in order that the optical fiber of said examples 1 and 2 of a proposal may exceed the threshold value to which the increase of loss by bending can be equal to cable use, It is difficult to expand the effective core cross section in the wavelength of 1550nm to two or more [80-micrometer], the effective core cross section is small also in the other wavelength range compared with the optical fiber of this example of an operation gestalt, and it was easy to be influenced of the nonlinear phenomenon.
[0047] According to the optical fiber of this example of an operation gestalt, the effective core cross section in the wavelength of 1550nm is expanded to two or more [90-micrometer] to it. And since zero dispersive wave length is set to about 1350nm like the above and the distributed inclination in this zero dispersive wave length is further made into 0.08ps(es)/km-nm2 It is hard to be influenced of a nonlinear phenomenon, and can consider as the outstanding optical fiber which enables wavelength division multiplex transmission in a large wavelength range.
[0048] Next, the example of the 2nd operation gestalt of the optical fiber concerning this invention is explained. Although the optical fiber of the example of a **** 2 operation gestalt has the almost same refractive-index profile as the above-mentioned example of the 1st operation gestalt, the example of a **** 2 operation gestalt is formed with the application of the different manufacture approach from the above-mentioned example of the 1st operation gestalt, and, thereby, is considered as the configuration which doped both germanium and a fluorine to a part of 2nd glass layer 2 approach of a clad 5.
[0049] That is, first, in the example of a **** 2 operation gestalt, as shown in drawing 7 , in case it carries out using three burners 11, 12, and 13 for a reaction, a germanium tetrachloride is mixed, respectively from the burners 11 and 12 for a reaction for formation of a core 6, and the burner 13 for a reaction for formation of a clad 5 to jet gas, and this adds germanium in it at a part of core 6 and 2nd glass layer 2 approach of a clad 5.
[0050] And in the ambient atmosphere glass containing the fluorine of a minute amount, transparence vitrification is

carried out, the obtained porosity base material is considered as dehydration and the configuration which doped both germanium and a fluorine by that cause to a part of 2nd glass 2 approach (part compounded by the vacuum arc heating decarbonizing process) of a clad, and the glass base material which has the refractive-index profile shown in drawing 6 is obtained. And in the example of a **** 2 operation gestalt, the refractive index of this part was made almost the same as that of the refractive index of the clad 5 formed by the outside vapor phase deposition method by balance of these dopants.
[0051] In addition, the production process after the above-mentioned transparence vitrification was made to be the same as that of the above-mentioned example of the 1st operation gestalt also in the example of a **** 2 operation gestalt.
[0052] About the optical fiber of this example of an operation gestalt, the evaluation result of the transmission characteristic of the above-mentioned optical fiber strand is shown in Table 2, drawing 8 , and drawing 9 , respectively.

[0053]
[Table 2]

	Δ1	α	Δ2	a/b	コア径b	1550分散値	零分散波長	零分散勾配	Aeff	λc
単位	%		%		μm	ps/km·nm	nm	ps/km·nm²	μm²	nm
	0.39	3	0.12	0.5	18.0	14.05	1356	0.08	99.3	1415

[0054] In the example of a **** 2 operation gestalt, 99.3 micrometers of effective core cross sections [in / in distributed inclination / in / variance / in the wavelength of 1550nm / in 14.05ps(es)/km-nm and zero dispersive wave length / 1356nm and zero dispersive wave length / 0.08ps(es)/km-nm2 and the wavelength of 1550nm] were set to 2 so that clearly from Table 2.
[0055] In addition, also in the example of a **** 2 operation gestalt, although not shown in Table 2, when bending loss for the diameter phi of 30mm in the wavelength of 1550nm becomes 0.1 dB/m and it considers as a cable 1km or more also in the example of a **** 2 operation gestalt, cut-off wavelength is set to 1300nm or less.
[0056] The example of a **** 2 operation gestalt can also do so the almost same effectiveness as the above-mentioned example of the 1st operation gestalt, and can make the wavelength field in consideration of generating of 4 light-wave mixing in which wavelength division multiplex transmission is possible the very large range of 1290nm - 1340nm and 1380nm - 1620nm in the example of a **** 2 operation gestalt. Moreover, in the example of a **** 2 operation gestalt, the transmission loss value in the wavelength of 1550nm is 0.194dB/km, and was able to consider as low transmission loss more nearly further than the above-mentioned example of the 1st operation gestalt.
[0057] The refractive-index profile of the example of the 3rd operation gestalt of the optical fiber concerning this invention is shown in drawing 10 . Like the above-mentioned example of the 1st and 2nd operation gestalt, the optical fiber of the example of a **** 3 operation gestalt has the 1st and 2nd glass layers 1 and 2 and a clad 5 (typical floor), further, in the example of a **** 3 operation gestalt, forms the 3rd glass layer 3 with a refractive index lower than a clad 5 between the 2nd glass layer 2 and a clad 5, and forms the optical fiber in it. Germanium is added by the 1st glass layer and the 2nd glass layer, and the fluorine is added by the 3rd glass layer.
[0058] In the example of a **** 3 operation gestalt, first, the VAD composition range (part used as a core 6) shown in drawing 11 is compounded by the vacuum arc heating decarbonizing process using two burners 11 and 12 for a reaction, as shown in drawing 12 . From the burners 11 and 12 for a reaction to jet gas, the germanium tetrachloride was mixed, respectively, and this has added germanium in the 1st and 2nd glass layers 1 and 2.
[0059] And in the ambient atmosphere glass which contains the fluorine of a minute amount for the obtained porosity base material, transparence vitrification was carried out, and dehydration and after extending so that it may become a setting outer diameter, the 3rd glass layer 3 was compounded with the outside vapor phase deposition method. Dehydration of this 3rd glass layer 3 and transparence vitrification were performed in the controlled atmosphere containing the fluorine of a minute amount, and were used as the glass containing a fluorine. Then, a fluorine was not added at the time of composition of a clad 5, but the clad 5 was used as the pure quartz. And this base material is used as the optical fiber strand which drew a line, and the result of having measured the transmission characteristic etc. is shown in Table 3, drawing 13 , and drawing 14 , respectively.
[0060]
[Table 3]

	Δ1	α	Δ2	a/b	Δ3	コア径b	1550分散値	零分散波長	零分散勾配	Aeff	λc
単位	%		%		%	μm	ps/km·nm	nm	ps/km·nm²	μm²	nm
	0.52	2	0.14	0.48	−0.15	18.0	15.05	1370	0.09	95.4	1290

[0061] In the example of a **** 3 operation gestalt; 95.4 micrometers of effective core cross sections [in / in

distributed inclination / in / variance / in the wavelength of 1550nm / in 15.05ps(es)/km-nm and zero dispersive wave length / 1370nm and zero dispersive wave length / 0.09ps(es)/km-nm2 and the wavelength of 1550nm] were set to 2 so that clearly from Table 3.
[0062] In addition, in the example of a **** 3 operation gestalt, cut-off wavelength was able to be set to 1300nm or less also in die length of 22m. Moreover, although not shown in a table, bending loss for the diameter phi of 30mm in the wavelength of 1550nm became 0.4 dB/m.
[0063] The example of a **** 3 operation gestalt can also do so the almost same effectiveness as the above-mentioned example of the 1st and 2nd operation gestalt, and can make the wavelength field in consideration of generating of 4 light-wave mixing in which wavelength division multiplex transmission is possible the very large range of 1290nm - 1340nm and 1380nm - 1620nm in the example of a **** 3 operation gestalt. Moreover, in the example of a **** 3 operation gestalt, the transmission loss value in the wavelength of 1550nm is 0.193dB/km, and was able to consider as low transmission loss more nearly further than the above-mentioned example of the 1st and 2nd operation gestalt.
[0064] In addition, this invention is not limited to the above-mentioned example of an operation gestalt, and can take the mode of various operations. For example, the optical fiber of this invention does not restrict having the refractive-index profile shown in each above-mentioned example of an operation gestalt, but it is set as a proper refractive-index profile so that it may become the light which has a property like each above-mentioned example of an operation gestalt.

[0065] Have a refractive-index profile as shown in drawing 1 and drawing 10 , and for example, the maximum relative index difference delta 1 over the typical floor of the 1st glass layer 0.35%<=delta1 <=0.7%, delta2 <=0.3%, if the ratio of the outer diameter a of the 1st glass layer and the outer diameter b of the 2nd glass layer is set to 0.3 <=(a/b) <=0.7, the minimum relative index difference delta 2 over said typical floor of the 2nd glass layer The optical fiber which has a property like the above 1st - the example of the 3rd operation gestalt can be constituted.
[0066] Moreover, although two-layer or a three-layer glass layer was prepared and formed inside the typical floor used as the criteria of refractive-index distribution in each above-mentioned example of an operation gestalt, the optical fiber of this invention may prepare and form a four or more-layer glass layer inside said typical floor.
[0067]
[Effect of the Invention] Since according to this invention zero dispersive wave length is set to 1350**30nm and the distributed inclination in this zero dispersive wave length is made into the larger value than 0.07 ps(es)/nm2/km In the wavelength range (for example, near 1300nm and a wavelength range 1400nm or more) except **20nm of zero dispersive wave length, can control the signal light distortion by 4 light-wave mixing, and Since the variance in the wavelength of 1520nm - the wavelength of 1600nm is made into 10-22ps/km-nm, in this wavelength within the limits, control of the signal light distortion by 4 light-wave mixing is attained at least, and wavelength division multiplex transmission is enabled in the setting wavelength range of large wavelength within the limits.
[0068] Moreover, in this invention, according to the configuration which made the effective core cross section in the wavelength of 1550nm two or more [90-micrometer], since the effective core cross section can be enlarged not to mention the wavelength of 1550nm also in the wavelength range (for example, 1400nm - 1600nm) of the circumference of it, control possible [of the signal light distortion by nonlinear phenomena other than 4 light-wave mixing] can be carried out certainly, and it enables wavelength division multiplex transmission of high quality further.
[0069] Furthermore, in this invention, according to the configuration which carried out transmission loss in the wavelength of 1550nm in 0.21dB/km or less, transmission loss in this wavelength can be made very small, and it is made to the optical fiber which fitted wavelength division multiplex transmission further.
[0070] Furthermore, according to the configuration which set cut-off wavelength to less than 1300nm, in this invention, implementation of wavelength division multiplex transmission in the wavelength range exceeding the wavelength of 1300nm can be aimed at.
[0071] Furthermore, in this invention, a core is considered as the configuration which has the 1st glass layer and the 2nd glass layer. Prepare the typical floor used as the criteria of refractive-index distribution in the periphery side of the 2nd glass layer, and the refractive index of the 1st glass layer is made higher than a typical floor. According to the configuration which made the refractive index of the 2nd glass layer it is lower than the 1st glass layer, and higher than a typical floor, and made the refractive index of the 1st glass layer alpha **, the optical fiber which does the above-mentioned effectiveness so can be manufactured comparatively easily, and the yield can also be made high.
[0072] Furthermore, in this configuration, an optical fiber can be manufactured still more easily by forming the 1st glass layer and the 2nd glass layer by the vacuum arc heating decarbonizing process of the same process, forming a typical floor at another process, or forming a part of core approach of the 1st glass layer, the 2nd glass layer, and a typical floor by the vacuum arc heating decarbonizing process of the same process.
[0073] Furthermore, even if the optical fiber of this invention prepares the 3rd glass layer with a refractive index lower than this typical floor between the 2nd glass layer and a typical floor in addition to the above-mentioned refractive-index profile, it can manufacture an optical fiber with the sufficient yield similarly.

[0074] Furthermore, by adding a fluorine to the typical floor formed by the vacuum arc heating decarbonizing process, adding a fluorine in the 3rd glass layer, or adding germanium in the 1st glass layer and the 2nd glass layer, and constituting, the optical fiber of this invention can realize the above-mentioned refractive-index profile easily, and can form easily the optical fiber which does the above-mentioned effectiveness so.
[0075] Furthermore, when the minimum relative index difference [as opposed to said typical floor of delta 1 and the 2nd glass layer for the maximum relative index difference over the typical floor of the 1st glass layer] is set to delta 2 in this invention, 0.35%<=delta1 <=0.7% and delta2 <=0.3%, according to the configuration which set the outer diameter of the 1st glass layer to 0.3 <=(a/b) <=0.7 when the outer diameter of a and the 2nd glass layer was set to b, a refractive-index profile can be determined as a detail and the optical fiber which does the above-mentioned effectiveness so can be obtained certainly.

[Translation done.]

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